

University of Pittsburgh NEUROSURGERY NEWS

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In-Utero Surgery Used to Successfully Treat Myelomeningocele at UPMC

A team of specialists at UPMC Children's Hospital of Pittsburgh and UPMC Magee-Womens Hospital — including the Department of Neurological Surgery's

Stephanie Greene, MD, director of Perinatal Neurosurgery, and **Stephen Emery, MD**, director of the Center for Innovative Fetal Intervention — performed UPMC's first in-utero surgery to close an open neural tube defect in a baby prior to birth.

The procedure was performed on a 28-year-old patient, Allee Mullen, whose fetus was diagnosed with a myelomeningocele, the most common type of spina bifida. The fetus was at 25 weeks' gestation at the time of the surgery, and was born two months later.

Spina bifida affects about 1,500 babies born each year in the United States. At UPMC Children's, physicians close defects like this following delivery in 10 to 20 infants each year.

A randomized controlled trial was performed at three centers in the United States to determine whether the fetal surgery was superior to conventional post-natal closure. All other pediatric neurosurgeons in the United States agreed to a moratorium on fetal closure of myelomeningocele while the trial was conducted. The study was stopped early because the in-utero surgery group demonstrated clear benefits in contrast to the control group. The trial results were published in the *New England Journal of Medicine* in 2011, showing that fetal surgery resulted in better lower extremity movement, produced resolution of the radiographic finding of Chiari II malformation (though the clinical consequences of this are unknown, as only a subset



Allee Mullen holds newborn daughter, Emery Greene Mullen, between her two surgeons: Dr. Stephen Emery (left) and Dr. Stephanie Greene (right).

of myelomeningocele patients develop a symptomatic Chiari II malformation requiring surgery and the patients in the study are not yet old enough to determine whether any of them will develop this condition), and cut the rate of surgical intervention for hydrocephalus in half. "This surgery has risks, but research shows that babies who are closed in-utero have better neurologic outcomes than babies treated after birth," says Dr. Emery.

(Continued on Page 6)

Free Online CME

To take the CME evaluation for this issue, visit our education website: UPMCPhysicianResources.com/Neurosurgery.

Affiliated with the University of Pittsburgh School of Medicine, UPMC Presbyterian Shadyside is ranked among America's Best Hospitals by *U.S. News & World Report*.

UPMC LIFE
CHANGING MEDICINE

Chairman's Message

Welcoming New Esteemed Faculty Members



As we move forward in continuing to meet the needs of our patients — as well as continue as leaders in academic neurosurgery — we are happy to welcome four new physicians to our faculty.

I am thrilled to welcome internationally renowned epilepsy neurosurgeon **Jorge Gonzalez-Martinez, MD, PhD**, to lead our comprehensive epilepsy and movement disorders program. Prior to joining our department, Dr. Gonzalez-Martinez was vice-chair of surgical operations at the Cleveland Clinic. During his tenure at the Cleveland Clinic, he built the preeminent epilepsy surgery center in the nation, evaluating and treating many patients travelling from national and international destinations. We are extremely fortunate to have recruited such an esteemed colleague.

We also welcome **Pascal Zinn, MD, PhD**, an accomplished neuroscientist studying novel personalized approaches for the treatment of brain tumors. Dr. Zinn — along with his wife, Dr. Rivka Colen (recruited by the Department of Radiology and the Hillman Cancer Center) — is performing groundbreaking work in the field of radiomics and radiogenomics and will strengthen our neurosurgery oncology program.

Michael J. Lang, MD, joins our team as a vascular and endovascular neurosurgeon specializing in the treatment of vessel diseases of the brain, including aneurysms, stroke, carotid artery stenosis, arteriovenous malformations and fistulas, cavernomas, and intracerebral hemorrhage. He performs both minimally invasive endovascular and traditional open and skull base surgery, allowing a comprehensive approach in the treatment of cerebrovascular disease.

Finally, we welcome back **Georgios Zenonos, MD**, a 2018 graduate of our residency program and an expert in endoscopic and complex cranial base surgery, to join our world-class cranial base team. Georgios is one of only a handful of neurosurgeons to have completed two fellowships in skull base surgery, one focusing on endoscopic and minimally invasive approaches, and another focusing on complex open skull base approaches.

I look forward to seeing the synergy and strength our new faculty bring to the department.

*Robert M. Friedlander, MD, MA
Chairman and Walter E. Dandy Professor of Neurological Surgery
Co-Director, UPMC Neurological Institute*

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Transitioning Neuroendovascular Practice to a Radial-Artery-First Strategy

by Jeremy G. Stone, MD

Over the past two decades, interventional cardiology emboldened radial artery access for coronary angiography culminating in a radial-first recommendation by the American Heart Association. This recommendation is due to a preponderance of large, prospective, randomized, multicenter trials showing reduced vascular/bleeding complications, improved patient satisfaction, and even a mortality benefit when radial access is utilized compared to traditional groin/femoral artery access cardiac catheterization.

Neuroendovascular surgery has been slower to adopt radial artery access due to a lack of comparable studies. Overcoming the learning curve of an alternative surgical approach, perceived limitations of accessing a smaller artery, navigating the aortic arch from a different vector, and challenges with regard to changing the culture among the many multidisciplinary staff within the angiography suite may all dissuade neurointerventionalists who have already mastered the transfemoral approach.

Motivated by a desire to both improve patient satisfaction and push our field forward, our group transitioned over the last year to a radial-artery-first strategy for diagnostic cerebral angiography. Throughout the process of transitioning to radial artery access for neuroendovascular procedures, we prospectively analyzed our success, identified limitations, and published on overcoming the learning curve. Consistent with cardiology data, we found the radial learning curve can be overcome within 30 to 50 cases, and high success can be achieved quickly when approaching the supra-aortic arteries via the right wrist.

With this institutional baseline established, we recently completed a prospective evaluation comprehensively comparing radial and femoral artery access for diagnostic cerebral angiograms. We compared our ability to successfully answer the diagnostic goal of the angiogram, patient safety, procedure times, and patient and staff satisfaction. Notably, we showed equivalent efficacy, radiation dose, contrast agent use, sedating medication use, procedure times, and minor complication rates between the two access approaches. Though procedure times were equivalent, recovery room time was significantly lower in wrist-access patients and discharge home time was faster for our outpatients. Patients



Figure 1. Right radial artery arteriogram.

overwhelmingly preferred wrist access over groin access with less access site pain, back pain, embarrassment, anxiety, and overall discomfort. Overall patient satisfaction was rated as significantly higher with wrist access compared to groin access.

Within months of transitioning our practice, patients referred for cerebral angiography were coming to the suite requesting wrist access for their procedures. Today, not only can we grant that request, we can confidently do so with the backing of scientific data supporting the safety and efficacy.

Note: Daniel A. Tonetti, MD; Merritt Brown, MD; Ashutosh Jadhav, MD, PhD; Bradley A. Gross, MD; and Benjamin M. Zussman, MD, also contributed to this article.

Preoperative Chronic Opiate Use Associated with Lower Postsurgical Clinical Outcomes After Complex Spinal Deformity Surgery

by David J. Salvetti, MD

Understanding the relationship between chronic opiate usage and surgical outcomes is critical to optimizing patient outcomes while minimizing potentially avoidable complications. Preoperative chronic narcotic usage has been shown to be associated with the inability to wean from narcotics postoperatively, decreased patient-reported outcome scores, and other complications. The purpose of this study was to evaluate the effect of preoperative narcotic use on patient-reported outcomes in the complex adult spinal deformity population.

All patients undergoing complex reconstructive spine surgery performed by the study's author from 2015 and 2016 were identified. Indications for surgery included iatrogenic flat back deformity, high-grade spondylolisthesis, adult idiopathic scoliosis, severe spondylosis, pseudarthrosis of prior fusion, proximal junctional kyphosis, and hardware failure. Patients with neoplasms, cervical, or cervicothoracic procedures were excluded. The cohort was divided into chronic opiate users and patients who were not chronic users of opiates. Chronic use was defined as evidence in the electronic medical record of opiate use greater than six months prior to surgery with a minimum morphine equivalent dosing of 30mg/day. Statistical analysis was then utilized to determine whether chronic opiate use was negatively associated with health-related quality of life (HRQOL) metrics postoperatively.

A total of 140 patients were included for analysis. Of these, 30 (21.4%) patients were categorized as chronic opiate users. Baseline pre-op surgical characteristics were analyzed for differences between non-opiate and opiate groups including BMI, age, length of surgery, ratio of males to females, surgical approach, surgical size, length of hospital stay, prior surgery, and spinopelvic measurements.

The opiate group demonstrated slightly worse pre-op sagittal vertical axis (SVA) measurements at a mean of 8 cm versus 6 cm for the non-opiate group ($p=0.03$). Additionally, 80% of patients in the opiate group had previously undergone spine surgery, versus 48.2% in the non-opiate group ($p=0.01$). No differences were identified in mean pre-op HRQOL metrics, including the Oswestry Disability Index (ODI), health state, visual analog scale (VAS) for back pain, and EQ-5D indices. At both six weeks and six months post operatively, patients in the opiate group demonstrated worse mean VAS back pain scores relative to the non-opiate group (6wk: 6.25 vs. 4.62, $p=.01$;

Variables	Chronic Opiates	No Chronic Opiates	p Value
# Patients	30	110	
Age in years, mean (SD)	60 (13)	60 (15)	0.94
M/F ratio	0.27	0.3	0.72
BMI – mean (SD)	29 (6)	30 (6)	0.62
Surgical Approach, n (%)			
Open	20 (66.6%)	71 (64.5%)	0.92
Hybrid	5 (16.7%)	17 (15.5%)	
cMIS	5 (16.7%)	22 (20.0%)	
Staged surgery, n (%)	7 (23.3%)	24 (21.8%)	0.86
OR time in min, mean (SD)	363 (90)	367 (90)	0.85
LOS in days, mean (SD)	6 (2)	7 (4)	0.97
Surgery Size, n (%)			
Lumbo-sacral	2 (6.6%)	7 (6.3%)	0.59
Lumbopelvic	6 (20.0%)	15 (13.6%)	
Thoracolumbar	3 (10.0%)	21 (19.1%)	
Thoracolumbar w/pelvis	19 (63.3%)	67 (60.9%)	
Prior Surgery, n (%)			
None	6 (20.0%)	57 (51.8%)	0.01
Decompression	3 (10.0%)	3 (2.7%)	
Lumbar Fusion	16 (53.3%)	33 (30.0%)	
Thoracolumbar Fusion	5 (16.6%)	17 (15.4%)	
Pre-op Measurements			
SVA in cm, mean (SD)	8 (5)	6 (5)	0.03
Pelvic tilt in deg	25 (9)	25 (10)	0.82
PI-LL mismatch	16 (14)	14 (9)	0.66
Post-op Measurements			
SVA in cm, mean (SD)	7 (4)	5 (5)	0.09
Pelvic tilt in deg	24 (7)	25 (10)	0.75
PI-LL mismatch	10 (12)	10 (13)	0.94

Table 1. Summary of Patient Demographics and Surgical Characteristics by Cohort

6mo: 5.4 vs. 4.2, $p=.05$). At six months postoperatively and at the last known (LK) clinical follow-up, ODI scores were higher in the opiate group (6mo: 42.8 vs. 31.2, $p=0.04$; LK: 42.4 vs. 31.5, $p =0.02$). There was no statistical difference in the rate of improvement in any HRQOL metrics between groups.

(Continued on Page 6)

Complications in Adult Spine Deformity Correction Using a Computer-Assisted Rod Bending System

by Nima Alan, MD

Rod contouring is a critical step in the correction of spinal deformity. However, manual rod contouring can be an arduous, time-consuming task at the late stage of surgery where blood loss from bony work is continuous. Bendini® (NuVasive; San Diego, Calif.) is a computer-assisted spinal rod bending system that expedites rod contouring. This tool can help reduce operation time and blood loss, in turn lowering the need for transfusion while following the principles of spine deformity correction. An *in vitro* study has shown that Bendini enhances screw pullout strength. However, because this system has yet to be studied in the clinical setting, its rate of complication is undescribed in the literature.

We performed a retrospective review to compare the rate of complications in patients who underwent deformity spine surgery with the use of Bendini versus traditional manual rod contouring. One hundred forty-two patients from 2015 and 2016 were included in this study, 88 for whom the Bendini system was used. There was no significant difference in the age (58.6 ± 16.3 versus 61.6 ± 12.2), number of fused levels (10.6 ± 4.1 versus 11.3 ± 4.8 , $P=0.4$), and length of follow up between the two cohorts (1.4 ± 0.6 versus 1.7 ± 0.4 years, $P=0.6$).

Intraoperative blood loss with the use of Bendini was 356 ml less ($p=0.18$) and the need to transfuse perioperatively was 2 units less ($p=0.21$). Length of surgery was on average 42 minutes faster ($p=0.16$). However, these differences were not statistically significant.

There were 30 complications necessitating revision surgery in the Bendini group compared to 13 complications in the other group, with the majority of complications being due to junctional kyphosis (60.0% vs. 53.8%), followed by rod/screw fracture (30.0% vs. 30.8%) and pseudarthrosis (10.0% vs. 15.4%).

There was no statistically significant difference in the rate or distribution of overall complications between groups as revealed by a two-proportion z-test.

In *de novo* operations, the rate of overall complications was statistically similar between groups. In patients with prior surgery, Bendini use was associated with a higher overall complication rate of 43.8% versus 25% for the manual rod contouring group, but not statistically significant ($p=0.09$). In those patients who underwent pedicle subtraction osteotomy and/or anterior column reconstruction, complications were more frequent in the Bendini group, with 36.4% of cases resulting in complications, versus 12% for the other group ($p=0.06$).

In summary, the use of Bendini was not statistically associated with a higher complication rate. However, in revision surgery, especially in severe deformities that required anterior column reconstruction or pedicle subtraction osteotomy, the use of Bendini showed a tendency toward a higher complication rate. Our case series did not demonstrate a statistically significant difference.

Note: Song Kim, BS; David Salvetti, MD; Nitin Agarwal, MD; Alp Ozpinar, MD; D. Kojo Hamilton, MD; Adam Kanter, MD; and David Okonkwo, MD, PhD, also contributed to this article.

	Total	Bendini	Manual	p Value
# Patients	142	88	54	
Age in years	59.7 ± 14.9	58.6 ± 16.3	61.6 ± 12.2	0.21
Sex:				
Male	43 (30.3%)	22 (25.0%)	21 (38.9%)	
Female	99 (69.7%)	66 (75.0%)	33 (61.1%)	
Fused Levels	10.9 ± 4.3	10.6 ± 4.1	11.3 ± 4.8	0.40
Length of hospital stay (days)	6.4 ± 3.6	6.0 ± 3.7	7.0 ± 3.4	0.09
Length of follow up (years)	1.5 ± 2.5	1.4 ± 0.6	1.7 ± 4.0	0.60

Data expressed as frequency (%) and mean \pm SD appropriate.
Independent Samples T-test in SPSS 25.0, 2 tailed significance, equal variances not assumed.

Table 1. Demographic Characteristics of Patients Undergoing Complex Spinal Deformity Correction

	Bendini (n=88)	Manual (n=54)	p Value
Complications:	30 (34.1%)	13 (24.1%)	0.21
PJK/PJF/DJK	18 (60.0%)	7 (53.8%)	0.71
Hardware failure ¹	9 (30.0%)	4 (30.8%)	0.96
Rod-related pseudarthrosis	3 (10.0%)	2 (15.4%)	0.61

¹Including 11 rod fractures, 1 rod pullout from iliac screw, and 1 pelvic screw fracture.

	Bendini	Total Bendini	Manual	Total Manual	p Value
De novo patient	9 (22.5%)	40	5 (22.7%)	22	0.98
Patient with prior surgery	21 (43.8%)	48	8 (25.0%)	32	0.09
	Bendini	Total Bendini	Manual	Total Manual	p Value
PSO/ACR	4 (36.4%)	11	1 (12.0%)	8	0.06
No PSO/ACR	26 (33.8%)	77	13 (28.3%)	46	0.53

Data expressed as frequency (%) and mean \pm SD appropriate.
2-Proportion Z-test in SPSS 25.0, asymptotic significance (2-sided).

Table 2. Complications in Patients Undergoing Complex Spinal Deformity Correction

Preoperative Chronic Opiate Use *(Continued from Page 4)*

There was also no statistical correlation between daily morphine equivalents and ODI scores. Lastly, the change in pre-op to LK follow-up of HRQOL metrics was not statistically different between groups.

In this group of complex spine surgery patients, chronic opiate use was associated with higher patient-reported VAS back pain scores at six weeks and at six months. This is an expected finding given preoperative opiate-induced hyperalgesia. Additionally, chronic opiate use was associated with higher ODI scores at six months and at last known follow-up. Further work is needed to determine whether strategies to wean patients from opiates preoperatively could improve outcomes or whether these differences merely represent a group with more severe pathology.

Note: Kamil Nowicki, MD, PhD; Nitin Agarwal, MD; Nima Alan, MD; Gurpreet Gandoke, MD; D. Kojo Hamilton, MD; Adam S. Kanter, MD; and David O. Okonkwo, MD, PhD, also contributed to this article.

Variables	Chronic Opiates	No Chronic Opiates	p Value
6 Weeks Post-Op			
ODI	49.7 (18.2)	47 (16.7)	0.58
Health State	65.8 (25.8)	70 (15.4)	0.41
Back Pain VAS	6.25 (2.3)	4.62 (2.3)	0.01
EQ5D	0.58 (0.2)	0.61 (0.2)	0.47
6 Months Post-Op			
ODI	42.8 (15)	31.2 (18.7)	0.04
Health State	70.2 (14.9)	72.3 (15)	0.63
Back Pain VAS	5.4 (2.4)	4.2 (2.7)	0.05
EQ5D	0.7 (0.2)	0.7 (0.2)	0.39
Last Known Scores			
ODI	42.4 (18.3)	31.5 (5)	0.02
Health State	69.2 (14.8)	72.8 (9)	0.36
Back Pain VAS	5.0 (2.8)	4.2 (5)	0.18
EQ5D	0.58 (0.24)	0.69 (5)	0.09
Timeframe (range in mo)	1.5-48	1.5-3.6	
Timeframe (mean in mo)	12.7	17.7	
Δ Scores (Pre-op – LK)			
Δ ODI	7.0 (15.5)	10.5 (19.4)	0.43
Δ Health State	-11.2 (17)	-14.2 (20.8)	0.55
Δ Back Pain VAS	2.5 (2.4)	3.2 (2.8)	0.35
Δ EQ5D	-0.13 (0.2)	-0.2 (0.2)	0.36

Table 2. Summary of Post-Op HRQOL Metrics

In-Utero Surgery Used to Successfully Treat Myelomeningocele *(Continued from Page 1)*

The surgical team trained in 2011 at one of the three centers involved in the study and waited for the perfect first set of patients, screening dozens in the interim. Allee, a nurse in the Pediatric Intensive Care Unit at UPMC Children's, was healthy, medically knowledgeable, and carrying a fetus without other structural or chromosomal abnormalities. Most importantly, she was willing to be the first patient to undergo this surgery in western Pennsylvania. In January 2019, an interdisciplinary team of maternal-fetal medicine, pediatric neurosurgery, obstetric anesthesiology, and cardiology specialists from both UPMC Magee and UPMC Children's performed the complex surgery on Mullen and her unborn baby.

Allee's baby girl was born at the average age for patients undergoing fetal surgery, about a month preterm. The baby was named Emery Greene Mullen after her two surgeons.

"Our initial tests show that Emery has almost entirely normal leg function," says Dr. Greene. "It can take up to a year to rule out hydrocephalus, but we are very hopeful. The neurologic outcome is definitely better than if her surgery had been done after birth." She has only weakness in dorsiflexion of her toes on one foot, and is otherwise neurologically intact. The skin of her back was completely healed by the time of birth. Now seven months after her birth, the young patient has not developed hydrocephalus or a symptomatic Chiari II malformation, and works regularly with physical and occupational therapists to maximize her leg function.

"We're very thankful for the surgeons. They not only changed Emery's life but also our whole family's lives," says Allee.

News & Notes

First Sports Medicine Fellowship Established

In what is considered to be the first program of its kind in the nation, the University of Pittsburgh Department of Neurosurgery has created a three-month sports medicine fellowship that will include rotations with the Pittsburgh Steelers, Pittsburgh Penguins, and other Pittsburgh-area sports programs. Fifth-year resident **Enyinna Nwachukwu, MD**, is serving the first fellowship.

"This fellowship will provide an excellent opportunity for interested residents to spend a dedicated period of their training with neurosurgeons that subspecialize in sports," said **Vincent Miele, MD**, UPMC neurosurgeon who was the driving force in establishing the fellowship. "Residents would also have the opportunity to rotate with other specialties such as neuropsychology, orthopedics, and athletic training. These rotations would allow the participant to experience how these specialties approach mutual pathologies that we treat as a team."

Renowned health and sports medicine expert **Joseph Maroon, MD**, and fifth-year resident **Nima Alan, MD**, also played a critical role in the development of the program.

Gamma Knife® Marks 32 Years and 16,000 Patients

On August 14, the **UPMC Center for Image-Guided Neurosurgery** marked 32 years treating patients with the Gamma Knife procedure. In those 32 years, the Gamma Knife staff has treated more than 16,000 patients, published hundreds of scientific articles in peer-reviewed medical literature, received countless awards, and established the center as a world leader in Gamma Knife research and education.

The Gamma Knife was brought to then Presbyterian University Hospital in 1987 by L. Dade Lunsford, MD, the center's long-time director. At the time, it was the first Gamma Knife installed in North America. Since then, the center has helped introduce and pioneer each succeeding generation of the unit, consulting closely with the Gamma Knife manufacturer, Elekta Instruments, to build new technologies for the future.

In marking the anniversary, Dr. Lunsford congratulated his staff, commenting that "it is a team effort of dedicated physician and nursing providers, the success of which 16,000 patients ago could hardly have been predicted. The vision of the leadership at that time allowed a relatively unknown technology to eventually change how we care for a wide spectrum of neurosurgical problems, greatly increasing the options that we can offer patients, while reducing the risk of collateral damage."

New Book Covers Radiosurgery Technology

Ajay Niranjan, MD, L. Dade Lunsford, MD, and Hideyuki Kano, MD, PhD, are co-editors of a newly released book volume, *Leksell Neurosurgery*, that presents an update on state-of-the-art radiosurgery technology, including outcomes. The book volume, published by Karger, is the 34th volume in the publisher's popular *Progress in Neurological Surgery* series.

According to Karger, the "book is a concise overview for physicians interested in radiosurgery. It will be of great value to neurosurgeons, radiation oncologists, and medical physicists concerned with learning about the indications of radiosurgery."

"Experts provide a history of the development of Leksell Gamma Knife and its evolution from frame-based to the inclusion of mask-based radiosurgery in the latest Gamma Knife model. For beginners, there is valuable information related to imaging, quality assurance, patient care, anesthesia, and regulatory requirements. Advanced users will appreciate the summary of the long-term outcomes of important indications. Additional chapters on cavernous malformation, orbital, uveal, and ocular disorders clarify the role of radiosurgery."

Special Media Appearances and Noted Lectures

David O. Okonkwo, MD, PhD, was featured on MedicalResearch.com in April discussing the results from the STEMTRA Phase 2 trial evaluating the efficacy and safety of SB623 in patients with chronic motor deficit from traumatic brain injury.

Joseph Maroon, MD, presented the inaugural Chuck Noll Foundation Lecture on Sports Related Trauma at the 2019 American Association of Neurological Surgeons Annual Scientific Meeting in San Diego, April 15. Dr. Maroon was also featured in a *Consumer Reports* article in February regarding the ability of cannabidiol — a compound found in marijuana — to help you sleep better.

A 12-year-old patient of **Stephanie Greene, MD**, with a rare arteriovenous malformation was featured on WTAE-TV (Pittsburgh) in April for his successful recovery.

L. Dade Lunsford, MD, was interviewed on NEJM Journal Watch Audio General Medicine in February discussing a published *JAMA Internal Medicine* article on corticosteroid treatment outcomes in adult patients with sepsis.

Congratulations

Sixth-year resident **Dan Tonetti, MD**, won best poster presentation at the 2019 Pennsylvania Neurosurgical Society Annual Scientific Meeting in July for his presentation, "Stent Retriever Salvage After Failed Manual Aspiration Thrombectomy." Fellow sixth-year resident **Michael McDowell, MD**, also took home a second place award in oral presentations for his talk on "Stimulation Threshold of the Facial Nerve in Patients Undergoing Microvascular Decompression." Dr. McDowell was appointed to the American Association of Neurological Surgeons Young Neurosurgeons History and Pediatric section delegations as liaison and alternate liaison, respectively.

Fifth-year resident **Nima Alan, MD**, was selected as a Council of State Neurological Societies (CSNS) Socioeconomic Fellow for 2019-20.

Percutaneous Balloon Kyphoplasty Determined Safe, Effective Method for Treatment of Vertebral Compression Fractures with Posterior Wall Disruption

by Alp Ozpinar, MD

Vertebral compression fractures (VCFs) are one of the most common comorbidities encountered in the elderly population. The incidence is increasing as the percentage of the aging population rises with an annual incidence of VCFs reaching 750,000 in the United States. The associated mortality rate in these patients is 2.5 times higher than in patients without VCFs. Nonoperative treatment, kyphoplasty, and vertebroplasty are available options for the management of symptomatic compressive vertebral fractures. Bed rest and analgesics for the management of VCFs are known to further accelerate bone loss and muscle wasting. Immobility can also result in systemic complications (pulmonary, cardiovascular, musculoskeletal, or immune) and are often responsible for decreasing survival rates in VCF patients.

Percutaneous balloon kyphoplasty (BK) is widely accepted as both a safe and effective method for the treatment of symptomatic benign vertebral compression fractures of the thoracic and lumbar spines. In addition to pain control, BK also allows for a correction of kyphotic deformity in certain cases. A disruption in the posterior wall of the affected vertebrae as seen on pre-procedure CT imaging is considered by many clinicians to be either a relative or an absolute contraindication to BK.

At UPMC, we have studied 114 consecutive patients (treated between 2010 and 2015) who were retrospectively identified with posterior wall disruption as determined on pre-procedure imaging. All cases were performed using a bipedicular technique by a single neurosurgeon. Each case was examined for cement leakage, anterior vertebral body height, improvement in pain determined by the visual analogue scale (VAS) score from baseline and one-month post procedure, and clinical sequelae from cement leakage. One hundred seven levels of BK were performed. No patient had radiographic evidence of cement leakage into the spinal canal; 14 (12%) cases had asymptomatic cement leakage outside of the vertebral body. The mean anterior vertebral body height was 14.35 ± 5.4 mm pre-procedure and 19.32 ± 5.3 mm post-procedure ($p=0.001$). Mean VAS was 8.7 pre- and 2.5 post-procedure ($p=0.001$). There were no cases of new neurological symptoms in any patient after BK.

Balloon kyphoplasty in the setting of posterior wall disruption as seen on pre-procedure imaging was found to be a safe and highly effective treatment for patients with benign compression fractures. Posterior wall disruption should not be considered a contraindication to BK. Patients can still achieve a high level of clinical success and safety in this setting.

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